COMPLEX ADAPTIVE SYSTEMS: THE THEATER AIR CONTROL SYSTEM IN DESERT STORM

A Monograph

by

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The warfighter of tomorrow will face an increasingly complex battlefield and should expect an adaptive and creative enemy. The Theater Air Control System (TACS) after Desert Storm became the de facto standard, even though the structure emerged during the conflict. As a result, the United States Air Force designated the Air Operations Center as a Major Weapons System and solidified the conceptual structure of the TACS. To date, the ability of the TACS to effectively accomplish centralized command and control has varied due to increased information gathering capabilities, which, in turn, requires improved information management and distribution. This monograph explores the following question: How can the United States Air Force modify the TACS to optimize the translation of strategy into advantageous effects on tomorrow's battlefield? The theory of Complex Adaptive Systems provides a framework to examine the TACS, specifically focusing on the variety of agents, interaction of agents, and selection mechanisms for adaptation. The TACS adapted throughout Desert Storm by modifying processes and organizations. Desert Storm provides insight into leverage points of effective and ineffective adaptation of the TACS. Successful adaptation indicates that increased variety or diversity of agents and purposeful behaviors are beneficial to overcoming complexity. Leaders play a key role in creating an environment of cooperation, collaboration, and competition that encourages innovation and risk-taking. Inaccurate Battle Damage Assessment failed to recognize the learning and adapting enemy and hindered Desert Storm operations. The TACS should embrace the creation of ad hoc organizations and networks to solve complex problems and then should adapt to integrate these solutions. The TACS must anticipate future needs then adapt to meet those needs through effective leadership that encourages innovation and diversity of ideas.

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Theater Air Control System, TACS, Complex Adaptive Systems, Adaptation, Desert Storm, United States Air Force, Air Operations Center, Variation, Agents, Interaction, Selection, Command and Control, Operational Planning, CENTAF, JFACC, Gulf War, Killer Scout, SCUD Hunt

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ABSTRACT

COMPLEX ADAPTIVE SYSTEMS: THE THEATER AIR CONTROL SYSTEM IN DESERT STORM, by Maj Travis D. Ruhl, USAF, 55 pages.

The warfighter of tomorrow will face an increasingly complex battlefield and should expect an adaptive and creative enemy. The Theater Air Control System (TACS) after Desert Storm became the de facto standard, even though the structure emerged during the conflict. As a result, the United States Air Force designated the Air Operations Center as a Major Weapons System and solidified the conceptual structure of the TACS. To date, the ability of the TACS to effectively accomplish centralized command and control has varied due to increased information gathering capabilities, which, in turn, requires improved information management and distribution.

This monograph explores the following question: How can the United States Air Force modify the TACS to optimize the translation of strategy into advantageous effects on tomorrow's battlefield?

The theory of Complex Adaptive Systems provides a framework to examine the TACS, specifically focusing on the variety of agents, interaction of agents, and selection mechanisms for adaptation.

The TACS adapted throughout Desert Storm by modifying processes and organizations. Desert Storm provides insight into leverage points of effective and ineffective adaptation of the TACS. Successful adaptation indicates that increased variety or diversity of agents and purposeful behaviors are beneficial to overcoming complexity. Leaders play a key role in creating an environment of cooperation, collaboration, and competition that encourages innovation and risk-taking. Inaccurate Battle Damage Assessment failed to recognize the learning and adapting enemy and hindered Desert Storm operations. The TACS should embrace the creation of ad hoc organizations and networks to solve complex problems and then should adapt to integrate these solutions. The TACS must anticipate future needs then adapt to meet those needs through effective leadership that encourages innovation and diversity of ideas.

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ACROYNYMS

AOC	Air Operations Center
ATO	Air Tasking Order
AWACS	Airborne Warning and Control System
CENTAF	United States Central Command Air Forces
CENTCOM	United States Central Command
CJCS	Chairman, Joint Chiefs of Staff
DIA	Defense Intelligence Agency
GAT	Guidance, Apportionment, and Targeting Cell
JFACC	Joint Force Air Component Commander
JSTARS	Joint Surveillance Target Attack Radar System
LANTIRN	Low-Altitude and Targeting for Night
OPORD	Operations Order
OPLAN	Operations Plan
SOF	Special Operations Forces
SPG	Special Planning Group
TACC	Theater Air Control Center
TACS	Theater Air Control System
TFW	Tactical Fighter Wing
USAF	United States Air Force

> Powerful global forces are emerging. Shifting centers of gravity are empowering smaller countries and non-state actors on the international stage. Global connections are multiplying and deepening, resulting in greater interaction between states, non-state entities, and private citizens … The operating environment is increasingly enabled by technology, which provides the types of capabilities once largely limited to major powers to a broad range of actors. The rapidly accelerating spread of information is … changing how wars are fought.[1]
>
> *United States Department of Defense Quadrennial Defense Review 2014*

INTRODUCTION

The warfighter of tomorrow will face an increasingly complex battlefield and should expect an adaptive and creative enemy. Airpower is an asymmetric advantage for the United States.[2] It provides flexibility and power projection while enabling the efficient and effective translation of strategy into battlefield effects. This capability has been continuously improved and refined since the Wright brothers' first flight. Airpower is a limited resource and limited resources require solutions that optimize efficiency without sacrificing effectiveness. The role of the United States Air Force (USAF) is to translate strategy into outcomes. The Theater Air Control System (TACS) is the system of systems the United States Air Force uses to conduct this translation. The purpose of the TACS is to reduce uncertainty while efficiently allocating the resources available.

The purpose of this monograph is to answer the following question: How can the USAF modify the TACS to optimize the translation of strategy into advantageous effects on tomorrow's battlefield? One plausible answer is to ensure that the TACS remain flexible and responsive to the current situation and context. The organization and the people must not remain static. The TACS

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[1] Department of Defense, *Quadrennial Defense Review 2014* (Washington, DC, March 2014), 3, http://www.defense.gov/pubs/2014_Quadrennial_Defense_Review.pdf (accessed March 25, 2014).

[2] Headquarters, Department of the Air Force, "Global Vigilance, Global Reach, Global Power for America," 2013, 3, http://www.af.mil/Portals/1/images/airpower/GV_GR_GP_300DPI.pdf (accessed November 24, 2013).

should embrace diversity of people, organizations, and strategies. The TACS should encourage interaction between people and organizations and the free exchange of ideas. TACS culture and leadership should balance cooperation and competition to identify and select better strategy translation processes and improved resource allocation.

The TACS is a complex system that translates strategy into effects at the operational level of war. This translation is composed of both the science and the art of planning, executing, and assessing air operations. The USAF's sub-system at the head of the TACS is the Air Operations Center (AOC). It is specifically tasked with planning, controlling, and assessing air operations. In September 2000, the Chief of Staff of the Air Force, Gen Michael Ryan, declared the AOC a weapons system based on the previous decade's experiences in Operation Desert Storm and Operation Allied Force.[3] With this designation, the AOC became the USAF's primary planning, command, and control vehicle for the application of air power. It is the senior element in the TACS. The AOC represents both symbolically and literally the air power tenet of centralized command and control and decentralized execution.

To date, the ability of the TACS to effectively accomplish centralized command and control has varied due to increased information gathering capabilities, which, in turn, requires improved information management and distribution. The amount of information available for analysis and synthesis has increased exponentially with the incorporation of new sensors and the networking of resources. Although the roots of air power command and control extend back before Desert Storm, the current conceptual configuration of the TACS emerged during Desert Storm and remains largely in place today.

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[3] Joseph H. Justice III, *Airpower Command and Control Evolution of the Air and Space Operations Center as a Weapon System*, Master's Thesis (Maxwell AFB, AL: Air University, May 3, 2004), 6, http://wwwldtic.mil/get-tr-doc/pdf?AD=ADA423705 (accessed November 26, 2013).

A US led Coalition conducted the air campaign during Operation Desert Storm for forty-three days over Iraq and Kuwait in January and February of 1991. It included a one hundred hour ground war that forced the withdrawal of all Iraqi forces from Kuwait. Desert Storm was the first significant major Joint military operation after the signing of the Goldwater-Nichols Department of Defense Reorganization Act of 1986. GEN Norman Schwarzkopf, Commander in Chief of United States Central Command during Desert Storm, appointed Lt Gen Charles Horner to be the first Joint Forces Air Component Commander (JFACC) in a major regional conflict.[4] The air campaign demonstrated the evolution of United States air power through the use and integration of standoff precision munitions, stealth technologies, and the Global Positioning Satellite system. These new capabilities led to the complete destruction of the Iraqi air defense network and Iraqi Air Force, crippling the Iraqi military command and control system, and destroying much of the Iraqi Army before ground operations commenced.[5] Desert Storm was an overwhelming strategic success for the United States due, in part, to the effectiveness of air power. The air campaign shaped and disrupted the Iraqi forces leading to a quick victory during the ground phase. The Coalition lost only thirty-eight fixed wing aircraft while destroying forty-one Iraqi aircraft and helicopters and roughly 3,800 tanks.[6] Desert Storm pushed Iraqi forces out of Kuwait and coerced Saddam Hussein to cease further acts of aggression.

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[4] Diane T. Putney, *Airpower Advantage: Planning the Gulf War Air Campaign 1989-1991* (Washington, DC: Air Force History and Museums Program: United States Air Force, 2004), 1, http://www.au.af.mil/au/awc/awcgate/afhistory/airpwr_advant.pdf (accessed January 17, 2014).

[5] Department of Defense, *Conduct of the Persian Gulf War*, n.d., xxii, http://www.ndu.edu/library/epubs/cpgw.pdf (accessed January 17, 2014).

[6] Ibid., xiv.

Methodology and Organization

The methodology of this paper is to investigate the historical application of air power using a systems lens. This paper will investigate Desert Storm in order to identify leverage points of effective and ineffective adaptation of the TACS. The theory of Complex Adaptive Systems will provide the framework to examine the TACS.

The second chapter will discuss systems theory, complexity theory, and Complex Adaptive Systems. The theory of Complex Adaptive Systems links the ideas of complexity and systems theory. This study will identify and describe specific characteristics of Complex Adaptive Systems. Specifically, this study will describe Complex Adaptive Systems in terms of the variation of agents and purposeful behaviors, key interactions, and selection mechanisms. These characteristics form the framework for exploring cases of adaptation during the planning and execution of Desert Storm.

The third, fourth, and fifth chapters will investigate the cases of adaptation during Desert Storm. The third chapter will focus on the adaptive planning process that occurred after Iraq invaded Kuwait up to the execution of Desert Storm. The fourth chapter will investigate the changes and modifications during the hunt for mobile Scuds launchers. The fifth chapter will explore the adaptations to operations that emerged in an effort to reduce the Republican Guard to fifty percent effectiveness before the ground war. The paper will conclude with recommendations for modifications to the TACS and future implications of viewing the TACS as a Complex Adaptive System.

COMPLEX ADAPTIVE SYSTEMS

Systems Principles

The TACS is a system. A system is a set of interacting or interdependent components forming an integrated whole. Likewise, the TACS is an interconnected collection of people, organizations, and processes. A variety of human, mechanical, and electronic devices links the people and organizations, which create a complex interdependence of actions and outcomes. A systems thinking approach is key to understanding complex systems. It is a conceptual method to understand complexity and a powerful tool when applied to organizations because it clarifies complexity and can improve internal integration.[7] Jamshid Gharajedaghi, a systems researcher and author, writes "when we understand something, we no longer see it as chaotic or complex."[8] The power of systems thinking lies in its ability to reveal greater understanding about a complex organization.

The TACS is an open system that interacts with a multitude of external variables such as the enemy, the weather, and the terrain. While openness relates to the system's relationship with the environment and context, emergence is a property of the system. A system's emergent properties are born from actions and interactions of the distinct parts and not solely a summation of the parts of the system.[9] Closely related to emergence is the concept of purposefulness. A purposeful system is a system that can learn, adapt, and create regardless of the environment.[10] A purposeful system not only has the ability to select the goals it wishes to attain, but can also

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[7] Peter M. Senge, *The Fifth Discipline: The Art and Practice of the Learning Organization*, rev. and updated. (New York: Doubleday/Currency, 2006), 12.

[8] Jamshid Gharajedaghi, *Systems Thinking: Managing Chaos and Complexity: A Platform for Designing Business Architecture*, 2nd ed. (Amsterdam ; Boston: Elsevier, 2006), 25.

[9] Ibid., 46.

[10] Ibid., 38.

modify those goals, and select the means by which to achieve those goals.[11] In other words a purposeful system demonstrates free will, the ability to adapt, and the ability to learn. Humans are examples of purposeful systems. They have the means to make changes in response to the environment in an effort to adapt and survive. The TACS displays purposefulness in that it attempts to defeat an adversary while surviving an adversary's attacks.

The TACS is a complex system. A complex system is a system composed of a great many agents (constituents, beings) that interact with each other in a great many ways.[12] M. Mitchell Waldrop, author of *Complexity: The Emerging Science at the Edge of Order and Chaos*, describes complex systems as residing "on the edge of chaos" because the system maintains its existence but never drifts into complete chaos or complete order. Many systems that demonstrate complex behavior are able to adapt in order to survive. A complex system demonstrates this ability through the interaction between independent agents without the presence of a central control mechanism. Waldrop describes the outcome of these interactions as "unconscious organization" or "spontaneous self-organization."[13]

The TACS is non-linear. Non-linearity occurs where inputs or causes to the system are not proportional to the outputs or effects.[14] Non-linearity offers a "multiplicity of choices to be made at points in the system."[15] Changes to the system create more options. In a system with

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[11] Russell L. Ackoff, "Towards a System a Systems Concept," *Management Science* 17, no. 11 (July 1971): 666.

[12] Mitchell Waldrop, *Complexity: The Emerging Science at the Edge of Order and Chaos* (New York: Simon & Schuster, 1992), 11.

[13] Ibid.

[14] Anne-Marie Grisogono, *The Implications of Complex Adaptive Systems Theory for C2*, 2006, 3, http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA463382 (accessed November 26, 2013).

[15] Ibid.

many agents making many small decisions, the number of outcomes for that system would be immense, yet the number of correct choices, in order to succeed, would be comparatively small. The vast number of agents coupled with the vast number of decisions creates a complex system. A shift in an agent's decision-making behaviors could aggregate to form a new emergent system characteristic.[16]

Self-organization is a key concept in an adaptable system. System adaptation is a system's process to survive in the environment. Evolution of a system links the concept of adaptation to a system that can and will modify itself in order to survive. Self-organization is a process by which this adaptation occurs via competition and cooperation in the pursuit of limited resources.[17] 'Fitness' is the ability of the system to adapt in order to survive. 'Learning' is the process by which the system adapts and this involves interaction with the environment. Learning requires more than the consumption of information. It requires active interaction with the environment that continually "expands it capacity to create its future."[18] John Holland, the father of Complex Adaptive Systems theory, argues that this evolution requires the system to anticipate its future and expected outcomes.[19] Anticipation and purposeful change imply a plan for the future version of itself that recognizes the past, the current environment, and a vision of the future. Anticipation is yet another emergent characteristic of Complex Adaptive Systems. Holland argues that anticipation is the one of the most important features of Complex Adaptive

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[16] Yaneer Bar-Yam et al., *Making Things Work: Solving Complex Problems in a Complex World* (Cambridge, MA: NECSI, Knowledge Press, 2004), 67.

[17] Thomas Y. Choi, Kevin J. Dooley, and Manus Rungtusanatham, "Supply Networks and Complex Adaptive Systems: Control Versus Emergence," *Journal of Operations Management* 19, no. 3 (2001): 356.

[18] Senge, *The Fifth Discipline*, 13.

[19] John H. Holland, "Complex Adaptive Systems," *Daedalus* 121, no. 1 (Winter 1992): 24.

Systems, yet the least understood.[20] For a system to be merely adaptable, it must anticipate change. However, for a system to be a Complex Adaptive System, it must not only anticipate change, but must do so with the purpose of adapting to survive.

Complex Adaptive System Characteristics

A Complex Adaptive System is an open system with the emergent characteristics of non-linearity, adaptability, and anticipation. Holland states, "Complex Adaptive Systems are systems that have a large numbers of components, often called agents, that interact and adapt or learn."[21] A Complex Adaptive System survives by adapting to other systems and to the surrounding environment. A Complex Adaptive System changes its "structure and behavior … over time in a way which tends to increase its 'success'."[22] Holland equates survival and success with the 'fitness' of a system and defines adaptive systems as a separate class of complex systems "that change and reorganize their component parts to adapt themselves to the problems posed by their surroundings."[23] The idea of a system that adapts in order to survive is useful for studying military systems because the enemy is an opponent that modifies the existing environment while attempting to destroy or dominate friendly systems.

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[20] Ibid., 20.

[21] John H. Holland, "Studying Complex Adaptive Systems," *Journal of System, Science, and Complexity* 19 (November 15, 2005): 1.

[22] Grisogono, *The Implications of Complex Adaptive Systems Theory for C2*, 4.

[23] Holland, "Complex Adaptive Systems," 18.

Agents

The basic building block for a Complex Adaptive Systems framework is an agent. Agents can be people, groups, or organizations. Agents interact with the environment and other agents.[24] Agents have properties that include location, capabilities, memory, and the ability to exhibit purposeful behavior.[25] Airmen within the TACS are all agents that interact with the environment and one another. Organizations occur when agents gather themselves to form a group. Thus, the organization is an agent. For example, the AOC is an organization that acts as an agent within the TACS.

Purposeful Behavior

Each agent has the ability to make purposeful decisions in pursuit of a desired outcome. This is purposeful behavior. This purposeful behavior of the agent in pursuit of its own goals as well as in relation to other agents is termed 'strategy' by Robert Axelrod and Michael D. Cohen in their book *Harnessing Complexity*.[26] However, in an effort to avoid confusion with the many other uses of the term strategy (business, military, national, etc.), this study will use the term *purposeful behavior*. Purposeful behavior implies that an agent has an awareness of both the external environment in addition to an internal model of expectations, beliefs, and values. Purposeful behavior can, and will, change over time based on interactions with the environment and other agents. Organizations, such as the AOC, exhibit purposeful behavior that determines interactions with other agents and the overall adaptability of the system.

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[24] Robert M Axelrod and Michael D Cohen, *Harnessing Complexity: Organizational Implications of a Scientific Frontier* (New York: Basic Books, 2000), 4.

[25] Ibid.

[26] Ibid.

Adaptive Mechanisms

According to Axelrod and Cohen, there are internal elements that make a Complex Adaptive System adaptive.[27] Variation, interactions, and a selection process are these internal elements. Variation is the differences in the internal details of a system in respect to agents and purposeful behavior.[28] Variation provides a scale of difference between parts within a system. Interaction is the contact and exchange of energy and/or information between agents. Interaction amongst agents provides the means for comparison between agents or agents' purposeful behaviors. The structure and hierarchy of a system influence interaction by determining which agents interact with each other, where those interaction occur, and the duration of interactions. Selection is the process of retaining or discarding variation in agents and purposeful behaviors in order to improve or degrade the success of the agent, system, or purposeful behavior. Selection requires assignment of a credit or strength to purposeful behaviors or agents in order to allow for comparison. This provides the path for evolutionary change through selection.[29] Selection is a process that, in order to promote overall system success, must eliminate success-decreasing variations most of the time, while, at the same time, retain the success-increasing variations.[30] The interplay between the elements of variation, interaction, and selection provides the means for adaptation to occur.

Likewise, these elements contribute to the possible levers of change in an adaptive system. The features of a Complex Adaptive System that must be understood in order to design a new system or to adapt a current system are the variation of agents and purposeful behavior, the

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[27] Ibid., 6–7.

[28] Grisogono, *The Implications of Complex Adaptive Systems Theory for C2*, 13.

[29] Holland, "Complex Adaptive Systems," 23.

[30] Grisogono, *The Implications of Complex Adaptive Systems Theory for C2*, 4.

interaction between agents based on physical and conceptual structure, and the selection process that chooses which agents, organizations, or purposeful behaviors survive into the future. The levers to modify the purposeful behavior of a Complex Adaptive System are variation, interaction, and selection.

Variation, Interaction, and Selection within the TACS

The TACS is a Complex Adaptive System with adaptations occurring via variation of agents and purposeful behaviors, interactions, and selections. The agents within the TACS include the individual airmen, the major weapons systems including all classes of aircraft (fighter, bomber, transport, re-fueling, command and control, unmanned aerial vehicle etc.), and the ground elements and organizations such as AOC, Air Support Operations Center, and Control Reporting Center. These agents are the primary source of variation within the TACS.

The structure of the TACS defines interactions between agents. The location and mobility of the agents is the physical structure of the TACS. Conceptual structure includes the connection of agents via telephone, radio, or data links. The structure of the TACS is a design feature that planners can modify.

The TACS selection mechanism includes decisions and interactions that create and destroy organizations and processes. Selection can occur purposefully or it can emerge based on the interactions of many agents. Leader's decisions affect the approach to problems and the identification of successful purposeful behaviors. Leadership is a source of selection processes within the TACS. The JFACC leads the TACS, as well as the AOC, which is the primary producer of processes and regulations within the TACS. JFACC interaction with the AOC or AOC-like structure can affect structure, process, regulation, and ultimately purposeful behavior of agents in the system. For instance, the apportionment of air power determines which parts of the battle space receive kinetic effects. Planners determine the basing for major weapons systems and

this, in turn, affects mission frequency and length. The centralized nature of the AOC within the TACS gives the JFACC more influence within the AOC, but this does not mean that the JFACC's intentions always lead to desired effects. "Practical drift" is one example of a selection process that emerges from within the TACS.[31] In Scott Snook's book, *Friendly Fire,* Snook describes "practical drift" as the tendency of agents to modify adherence to global procedures over time for pragmatic reasons.[32] This drift in essence is the selection of a new purposeful behavior and is definitive proof that the TACS has both conscious (design based) and emergent selection mechanisms. Characteristics like "practical drift" emerge from the purposeful behavior and interactions of many agents. Characteristics like "practical drift" are evidence of emergent properties that can lead to a selection process. This study will investigate specific adaptations during Desert Storm based on variation of agents, the interaction of agents, and the selection process. This lens will allow for a focused view of the TACS in action.

[31] Scott A Snook, *Friendly Fire: The Accidental Shootdown of U.S. Black Hawks over Northern Iraq* (Princeton, NJ: Princeton University Press, 2002), 193.

[32] Ibid.

DESERT STORM PLANNING: UNPLANNED VARIATION

During Operation Desert Storm, the air campaign emerged from three planning efforts: Operations Plan (OPLAN) 1002-90, Instant Thunder, and the deployed Central Command Air Forces (CENTAF) plan. The roots of the air campaign for Desert Storm started with the development of OPLAN 1002-90, which was the US Central Command's (CENTCOM) plan to defend the Arabian Peninsula from a regional attack. The end of the Cold War spurred the development of OPLAN 1002-90. Planners modified the primary threat from the Soviet Union to Iraqi.[33] The development of OPLAN 1002-90 dominated planning in the latter half of 1989 and lasted until the Iraqi invasion of Kuwait.[34] OPLAN 1002-90 focused on defense and deployment, but not the employment of forces.[35] CENTAF, as the air component to CENTCOM, created the air plan for OPLAN 1002-90. Lt Gen Horner, the CENTAF commander, briefed and received approval for the CENTAF plan from GEN Schwarzkopf, the CENTCOM commander, in April 1990. As the CENTCOM commander, GEN Schwarzkopf was in charge of the component forces acted as as the chief CENTCOM strategist.[36] Lt Gen Horner and GEN Schwarzkopf developed mutual trust and understanding during the development of OPLAN 1002-90.

The Internal Look exercise tested and updated OPLAN 1002-90. Internal Look evaluated OPLAN 1002-90 against an Iraqi adversary consisting of six heavy divisions that invade Kuwait and Saudi Arabia. The primary exercise lesson was that, regardless of how many fixed wing and attack helicopters that US forces used, Iraqi armor formations would inflict heavy losses on

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[33] Putney, *Airpower Advantage: Planning the Gulf War Air Campaign 1989-1991*, 11.

[34] Ibid.

[35] Ibid., 17.

[36] Ibid., 9.

Coalition forces.[37] Planners learned that success required heavy attrition of Iraqi forces. The Iraqi invasion into Kuwait ended the CENTCOM and CENTAF OPLAN 1002-90 planning efforts as the focus shifted to the real world deployment and defensive operations in Saudi Arabia.[38] OPLAN 1002-90 created the foundation for initial CENTCOM and CENTAF actions that led to Operation Desert Storm.

GEN Schwarzkopf requested that the USAF Air Staff lead the next planning effort. The plan produced became known as the Instant Thunder plan. GEN Schwarzkopf realized that CENTAF would not have the capacity to simultaneously plan an air campaign and deploy to Saudi Arabia. He needed an air campaign option to present to the President, so he called the Air Staff on 8 August 1990. This effort was outside of the normal planning processes and structure. GEN Schwarzkopf felt he needed "broader planning" than what was available at CENTCOM. He requested that the Air Staff create a "strategic air campaign," a "strategic bombing campaign," and a "retaliatory air campaign" that could be quickly executed against Iraq.[39]

Colonel John A. Warden III, the director of the Deputy Directorate for Warfighting Concepts better known as Checkmate, led the Air Staff planning effort. Instant Thunder primarily focused on a strategic air campaign with the objective of isolating Saddam Hussein from both his government and the Iraqi people. Col Warden envisioned execution over a six to nine day period in August.[40] Planners intended for Instant Thunder to increase the strategic cost to Iraq of

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[37] Ibid., 19.

[38] Ibid., 32.

[39] Ibid., 33.

[40] Ibid., 54.

remaining in Kuwait.[41] The initial plan focused on targeting eighty-four strategic targets and not on Iraq's fielded forces.[42]

While at National War College in 1986, Col Warden authored a study on air campaign planning titled *The Air Campaign: Planning for Combat*.[43] The Instant Thunder plan grew out of Warden's ideas on air power as espoused in *The Air Campaign.* He saw the Iraqi invasion of Kuwait as an opportunity to "sell" his ideas and beliefs on air power.[44] He developed a five-ring model that represented a nation's center of gravity in a bulls-eye format of concentric rings with national leadership at the center.[45] Instant Thunder focused on the isolation of the center ring. Col Warden believed that Instant Thunder, alone, would compel Iraq to leave Kuwait.[46]

Col Warden assembled an "extraordinarily energized and creative group of officers" who believed that they would be contributing to a significant chapter in air power history.[47] As Instant Thunder developed, additional planners joined Checkmate from the Navy, the Marine Corps, Strategic Air Command, Tactical Air Command, and other divisions within the Air Staff.[48] Col Warden's vision and the unique composition of Checkmate fostered the creation of Instant

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[41] Ibid., 51.

[42] Eliot A. Cohen, ed., *Gulf War Air Power Survey* (Washington, DC: Office of the Secretary of the Air Force, 1993), Vol I, Part I, 112.

[43] Ibid., Vol I, Part II, 8.

[44] Putney, *Airpower Advantage: Planning the Gulf War Air Campaign 1989-1991*, 43.

[45] Ibid., 39.

[46] Ibid., 50.

[47] Ibid., 44.

[48] Cohen, *Gulf War Air Power Survey*, Vol I, Part I, 115; Putney, *Airpower Advantage: Planning the Gulf War Air Campaign 1989-1991*, 63.

Thunder. CENTAF and Tactical Air Command, on the other hand, would have produced a fundamentally different plan.[49]

Before departing for Saudi Arabia, CENTAF did have input into Instant Thunder in the form of the "Punishment Air Tasking Order (ATO)." The "Punishment ATO" consisted of seventeen targets and an accompanying ATO focused on a single retaliatory response to a preemptive Iraqi chemical Scud attack on US forces.[50] The "Punishment ATO" planning effort did not include "provision for transitioning to large-scale, continuous offensive operations" and the effort ended with the deployment to Saudi Arabia.[51] The target list was provided to Checkmate and was merged into the Instant Thunder plan.[52]

The Commander of Tactical Air Command, General Bob Russ, requested to receive the Instant Thunder brief from Col Warden because he had some serious issues with the premise of the plan.[53] Gen Russ was the senior four star general in the Air Force. He was senior in rank to the Chief of Staff, Gen Michael Dugan, and his opinion influenced generals on both the Tactical Air Command staff and the Air Staff.[54] In Gen Russ' opinion, Air Staff planning conducted at the Pentagon was a mistake similar to Vietnam, in which target selection occurred in Washington, DC. In addition, he disagreed with Col Warden that the Instant Thunder plan alone could achieve

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[49] Putney, *Airpower Advantage: Planning the Gulf War Air Campaign 1989-1991*, 73.

[50] Ibid., 31; Cohen, *Gulf War Air Power Survey*, Vol I, Part I, 139.

[51] Cohen, *Gulf War Air Power Survey*, Vol I, Part I, 140.

[52] Putney, *Airpower Advantage: Planning the Gulf War Air Campaign 1989-1991*, 48.

[53] Richard T. Reynolds, *Heart of the Storm, The Genesis of the Air Campaign Against Iraq* (DTIC Document, 1995), 49, http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA292091 (accessed January 26, 2014).

[54] Putney, *Airpower Advantage: Planning the Gulf War Air Campaign 1989-1991*, 34.

Presidential and CENTCOM objectives.[55] Gen Russ believed in a more graduated air campaign that emphasized interdiction and close air support of the ground forces.[56] This matched the Tactical Air Command commitment to the US Army's doctrine of AirLand Battle. [57] The direct support of ground forces was central to AirLand battle and placed the strategic application of air power as described in Instant Thunder in a tertiary role.

Gen Dugan decided that Gen Russ did not need to be briefed prior to GEN Schwarzkopf, even though Lt Gen Horner reported directly to Gen Russ and many on Gen Dugan's staff thought it was the prudent thing to do. As a result, Col Warden and his team briefed GEN Schwarzkopf without input from Tactical Air Command. Later, a Tactical Air Command produced plan arrived at the Pentagon along with three Tactical Air Command planners. Given GEN Schwarzkopf's approval of Instant Thunder and Gen Dugan's decision to skip Tactical Air Command, Col Warden dismissed the Tactical Air Command plan and integrated the Tactical Air Command planners into Checkmate planning operations.[58] This limited Tactical Air Command conceptual inputs to the Instant Thunder plan.

The approval of Instant Thunder as a plan occurred through a series of briefings to GEN Schwarzkopf, the Air Staff, and the Joint Staff between August 10 and August 17. GEN Schwarzkopf approved the plan because it gave him a retaliatory option, especially before the introduction of credible ground forces into Saudi Arabia.[59] The Chairman of the Joint Chiefs of

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[55] Ibid., 56.

[56] Cohen, *Gulf War Air Power Survey*, Vol I, Part I, 114.

[57] Richard G. Davis, *On Target: Organizing and Executing the Strategic Air Campaign Against Iraq* (Air Force History and Museums Program: United States Air Force, 2002), 54, http://www.afhso.af .mil/shared/media/document/AFD-100928-035.pdf (accessed January 17, 2014).

[58] Reynolds, *Heart of the Storm, The Genesis of the Air Campaign Against Iraq*, 75.

[59] Cohen, *Gulf War Air Power Survey*, Vol I, Part I, 112.

Staff (CJCS), GEN Colin Powell, agreed with the strategic first phase of Instant Thunder, but directed the Col Warden to develop a second phase that would "leave smoking tanks as kilometer posts all the way to Baghdad." GEN Powell disagreed with the premise that a strategic air campaign could end the war.[60] As a result, Checkmate added a Phase II to Instant Thunder that focused on Iraqi forces in Kuwait. After the second brief on August 17, GEN Schwarzkopf directed Col Warden to go to Riyadh, Saudi Arabia to hand off the plan to Lt Gen Horner. GEN Schwarzkopf intended for Lt Gen Horner to assume control of the planning process in theater.

Lt Gen Horner received the Instant Thunder brief on August 20 and asked the three lieutenant colonels that accompanied Col Warden to stay and support the planning effort. He pointedly did not ask Col Warden to stay.[61] Lt Gen Horner viewed Instant Thunder as a seriously flawed plan because it did not take into consideration the defense of Saudi Arabia.[62] At this point, the Instant Thunder plan consisted of a 180-page Operations Order (OPORD) and thirty briefing slides.[63] Lt Gen Horner described Instant Thunder as a "larva" that could now be developed into a "butterfly" of a theater air campaign.[64] Accordingly, CENTAF integrated Instant Thunder into the ongoing defensive planning efforts.

The ongoing CENTAF planning was the third planning effort and led to the Desert Storm air campaign. This planning effort occurred simultaneously with the Checkmate effort. GEN Schwarzkopf appointed Lt Gen Horner to be the CENTCOM Forward commander responsible for

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[60] Putney, *Airpower Advantage: Planning the Gulf War Air Campaign 1989-1991*, 63.

[61] Ibid., 128.

[62] Ibid., 131.

[63] Ibid., 144.

[64] Ibid., 132.

the initial deployment flow and defense of Saudi Arabia.[65] This shaped the initial planning effort by placing the threat of further Iraqi attack at the forefront of CENTAF's planning priorities. GEN Schwarzkopf returned to Saudi Arabia on August 28 and at that time Lt Gen Horner assumed the duties of the JFACC full time. He would be responsible for planning and executing Joint air operations during Operation Desert Storm.

The CENTAF planning effort for Desert Shield and Desert Storm consisted of two distinct groups. Col James C. Crigger Jr., the CENTAF Deputy Chief of Staff Operations, led the first planning effort with planners deployed from CENTAF.[66] When this group of planners arrived in Saudi Arabia, they began work on the "D-Day Plan" that focused on forty-eight hours of air strikes in the face of a large scale Iraqi attack. Leading up to Desert Storm, the personnel assigned to CENTAF focused on creating and implementing an ATO production process that efficiently tasked air power.[67] Many of these personnel remained assigned to CENTAF for over four years due to budget restraints that limited personnel movements with the Air Force. This created an extremely cohesive and experienced team.[68]

The D-Day plan relied heavily on OPLAN 1002-90 and products from the Internal Look exercise. The plan included a detailed air tasking order for the first day and rough planning for the second day.[69] Col Crigger's group also produced a daily training ATO that operationalized the D-Day plan and allowed its elements to be exercised prior to the start of Desert Storm. CENTAF

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[65] Ibid., 28–29.

[66] Perry D. Jamieson, *Lucrative Targets: The US Air Force in the Kuwaiti Theater of Operations* (Air Force History and Museums Program: United States Air Force, 2001), 20, http://oai.dtic.mil/oai/oai ?verb=getRecord&metadataPrefix=html&identifier=ADA439960 (accessed January 18, 2014).

[67] Ibid., 17.

[68] Davis, *On Target: Organizing and Executing the Strategic Air Campaign Against Iraq*, 10.

[69] Cohen, *Gulf War Air Power Survey*, Vol I, Part I, 136.

integrated elements of the D-Day plan into the Desert Storm air campaign.[70] The D-Day plan formed the foundation for Coalition training and it provided a façade for masking the scope and intent of future offensive operations.[71] Lt Gen Horner directed Col Crigger to develop an offensive plan for attacking Iraqi ground forces inside of Kuwait. Col Crigger developed this plan with aircraft not essential to the Instant Thunder Phase I plan. Col Crigger based the Kuwait offensive plan on the Instant Thunder Phase II planning and Instant Thunder OPORD from Checkmate.[72]

Brig Gen Buster C. Glosson led the second group of CENTAF planners. Lt Gen Horner hired Brig Gen Glosson to plan the offensive air campaign. In Lt Gen Horner's opinion, Brig Gen Glosson was a "go-getter" who "got things done."[73] Brig Gen Glosson had worked for Lt Gen Horner both as a squadron commander and as a wing commander.[74] The name of Brig Gen Glosson's group was the Special Planning Group (SPG). The SPG was a highly classified effort to produce an offensive air plan. Access to the SPG was restricted because of Arab sensitivities to US offensive operations conducted from Saudi Arabia and the surrounding Gulf Coast States. As a result, most of the CENTAF staff did not interact with the SPG or understand its purpose. Initially, Lt Gen Horner instructed Brig Gen Glosson to produce an offensive plan based on

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[70] Putney, *Airpower Advantage: Planning the Gulf War Air Campaign 1989-1991*, 98.

[71] Cohen, *Gulf War Air Power Survey*, Vol I, Part I, 139.

[72] Putney, *Airpower Advantage: Planning the Gulf War Air Campaign 1989-1991*, 144.

[73] Ibid., 136.

[74] Ibid.

Instant Thunder.[75] Instant Thunder Phase I formed the foundation of the offensive plan produced by the SPG, which became Phase I of the Desert Storm air campaign.[76]

Lt Gen Horner decided to send Col Warden home to sever the connection with Checkmate and the Pentagon. In the short-term, Lt Gen Horner decided to retain the three lieutenant colonels who traveled with Col Warden to ensure that the CENTAF planners understood the Instant Thunder plan. Of the three, only Lt Col David Deptula stayed throughout the planning and execution of Desert Storm. He was a key leader within the SPG and this assured that the Instant Thunder plan would be included in the final air campaign. Lt Col Deptula remained as the intellectual link to the Instant Thunder plan and Checkmate. Brig Gen Glosson personally hired the members of the SPG to include an expert on building ATOs, a person familiar with building operations orders, representatives familiar with execution planning, logistics, and Joint representatives from the Navy, Marine Corps, and Army. These officers were primarily from the CENTAF headquarters and included a group of intelligence officers responsible for overall intelligence and targeting. After building the core group, Brig Gen Glosson requested that each operational flying wing contribute two representatives. The officers sent from the wings were in Brig Gen Glosson's opinion "very bright" officers and "top-drawer guys."[77] Because of the SPG's high classification and the initial Checkmate members, the CENTAF staff viewed the SPG as a group of "outsiders." The isolation, small number of personnel involved, predominately non-CENTAF composition, and the varied backgrounds and assignments of the SPG personnel led to enhanced personal relationships, increased esprit de

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[75] Ibid., 137.

[76] Cohen, *Gulf War Air Power Survey*, Vol I, Part II, 162.

[77] Putney, *Airpower Advantage: Planning the Gulf War Air Campaign 1989-1991*, 141.

corps, and increased cohesion within the SPG.[78] A schism developed between the SPG and CENTAF staff.

In December 1990, Lt Gen Horner ordered the re-organization and physical relocation of the Tactical Air Control Center (TACC) in order to combat this schism. The TACC was the forerunner to the modern day AOC and conducted the planning and ATO production for the air campaign. This proved to be a key adaptation of the TACS and it occurred just over thirty days before the execution of Desert Storm. Two factors drove the re-organization of the CENTAF staff. First, the offensive planning for Desert Storm was nearly complete and did not require large changes in the future. Second, Lt Gen Horner recognized that the isolation of the SPG would impede the ATO creation process, especially after the first two days of execution. Lt Gen Horner intended to merge Col Crigger's defensive, training, and ATO building operation with the SPG planning organization in order to create "fast, frictionless generation of daily ATOs for the offensive air campaign."[79]

The re-organization involved a conceptual redesign of TACC operations and a physical move. Lt Gen Horner placed Brig Gen Glosson in charge of the newly formed Campaign Plans Division, which incorporated the SPG and the ATO process, further reinforcing the re-organization and integration.[80] The Guidance, Apportionment, and Targeting cell (GAT) emerged during the re-organization, which merged the SPG's strategic plan with Col Crigger's Kuwait focused plan.[81] The emergent organization represented a shift from defense and training to offensive operations that would require an efficient repeatable production of ATOs. The physical

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[78] Cohen, *Gulf War Air Power Survey*, Vol I, Part I, 180.

[79] Putney, *Airpower Advantage: Planning the Gulf War Air Campaign 1989-1991*, 310.

[80] Cohen, *Gulf War Air Power Survey*, Part I, Vol II, 200.

[81] Ibid., Vol I, Part II, 8.

move reinforced the merging of the offensive planning with the larger CENTAF organization by placing all the divisions into the basement of the Royal Saudi Air Force building. This brought the SPG planners into regular direct contact with the CENTAF ATO builders.[82] Although the re-organization helped, the move did not fully integrate the staff. The SPG security restrictions were not lifted and, as a result, only few additional personnel were read into the Desert Storm plan.[83] The TACC re-organization completed the last major adaptation prior to the execution of Desert Storm.

Variation

During Desert Storm planning, agents increased variation within the TACS and this substantially effected planning. First, GEN Schwarzkopf's request to Air Staff created the most significant variation within the TACS. The "strategic campaign" created variation in approach. This variation gave GEN Schwarzkopf and Lt Gen Horner a second opinion to compare to the CENTAF planning produced for OPLAN 1002-90. GEN Schwarzkopf effectively increased the variation in the TACS by requesting assistance from the Air Staff. The composition of Checkmate, including the leadership and vision of Col Warden, ensured that Instant Thunder was conceptually different from OPLAN 1002-90, the "Punishment ATO," or the Tactical Air Command plan. The Instant Thunder plan emerged from this increased variation.

Second, Lt Gen Horner's creation of the SPG created additional variation within the TACS. The SPG focused on creating a offensive air plan. Brig Gen Glosson reinforced this variation with the predominately non-CENTAF composition of the SPG. The root of SPG's air plan was the Instant Thunder plan. The SPG's isolation allowed the Instant Thunder plan to grow

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[82] Putney, *Airpower Advantage: Planning the Gulf War Air Campaign 1989-1991*, 310.

[83] Ibid.

into a fully developed executable plan. The Master Attack Plan and strategic air plan for Desert Storm emerged from the increased variation.

Third, the diversity of the plan is dependent upon the internal variation of agents within the organization creating the product. CENTCOM was a Joint organization that provided the overarching guidance for OPLAN 1002-90, specifically focused on deployment, logistics, and defensive actions. CENTAF personnel, on the other hand, were highly experienced in planning air operations based on years of cumulative experience. Once deployed, CENTAF focused on the nearest threat, the Iraqi forces in Kuwait. Tactical Air Command was the lead Air Force organization responsible for the training and integration of air power into the Army's AirLand Battle doctrine. The unique composition of Checkmate, with Col Warden's leadership, resulted in the unique approach to Instant Thunder. Similarly, the composition of the SPG was unique and internal variation translated into strategic air campaign. A diversity of agents created a diversity of solutions while planning during Desert Storm.

Key Interactions

The relationship between GEN Schwarzkopf and Lt Gen Horner formed a key interaction. During the development of OPLAN 1002-90, Lt Gen Horner gained the trust of GEN Schwarzkopf as demonstrated by GEN Schwarzkopf's decision to initially place Lt Gen Horner in charge of CENTCOM Forward. Lt Gen Horner believed that asking the Air Staff to conduct planning was a mistake and would result in a Vietnam-like situation with planners in Washington DC picking targets disconnected from the realities in the theater of operations, but supported Instant Thunder none the less. GEN Schwarzkopf reassured Lt Gen Horner by informing him that he would assume full responsibility for the air plan once the preliminary work was complete.[84]

[84] Ibid., 32.

This would allow Lt Gen Horner to select the portions of the air campaign deemed most useful, while ignoring those that did not fit into either GEN Schwarzkopf's or Lt Gen Horner's concept of operations. Ultimately, Instant Thunder formed the foundation and structure for the Desert Storm air campaign.

The isolation of the SPG was the key (non) interaction that led to the emergence of an ad hoc support network. The isolation restricted the interaction with the CENTAF and CENTCOM intelligence organizations. Due to this friction, the SPG developed an informal communications network connected to the US defense establishment outside the CENTCOM area of responsibility. Each time the SPG encountered resistance or a lack of support from CENTAF Intelligence, they would accomplish the task within the SPG or reach back to the United States to gain support. Lt Col Deptula and Brig Gen Glosson relied on Checkmate and the Defense Intelligence Agency (DIA) to provide responsive intelligence data and services in a fraction of the time it would have taken CENTAF or CENTCOM.[85] Before Desert Storm, Brig Gen Glosson had developed an extensive network that connected him with senior national US leaders and senior diplomatic leaders in the Gulf States.[86] Brig Gen Glosson's contacts created an extension of the SPG that was broader in scope and more responsive than the CENTAF/CENTCOM Intelligence structure. An informal network emerged to resolve specific intelligence shortfalls and problems. The agents within the SPG adapted to the organizational frictions in order to accomplish the assigned task in the limited time available. This expanded the capabilities of the SPG without increasing the size of the organization.

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[85] Cohen, *Gulf War Air Power Survey*, Vol I, Part II, 185 .

[86] Ibid., Vol I, Part II, 184.

Lt Gen Horner's and Brig Gen Glosson's direct involvement with the development of the Desert Storm air plan resulted directly from many interactions with the SPG. Brig Gen Glosson would meet regularly, both formally and informally, with Lt Gen Horner to receive updated guidance and critiques of the planning in progress. Brig Gen Glosson, in turn, would pass this information on to Lt Col Deptula for inclusion in the overall SPG planning effort.

Selection Mechanisms

The first key selection mechanism involved GEN Schwarzkopf, Lt Gen Horner, and Instant Thunder. The selection mechanism in this case was GEN Schwarzkopf's delegation of authority coupled with Lt Gen Horner's acceptance of the Instant Thunder plan and the three Air Staff experts, but not the zealous Instant Thunder creator, Col Warden. GEN Schwarzkopf assured Lt Gen Horner that he would assume full authority for the air plan once Instant Thunder arrived in Saudi Arabia. This allowed Lt Gen Horner to integrate the Instant Thunder plan into the CENTAF planning effort. Lt Gen Horner reinforced the selection by retaining Lt Col Deptula and dismissing Col Warden.[87] The lesson is that an independent option developed by an organization with a different composition can benefit the planning process as long as the authority that must execute the plan makes the final selection decision.

The second key selection mechanism was the SPG access to CENTAF senior leadership reinforced by the SPG's isolation. The isolation allowed Lt Gen Deptula and the SPG to develop a new ATO building and targeting process in the form of the Master Attack Plan. Lt Col Deptula insisted on using his newly developed Master Attack Plan as the starting point for ATO production, as opposed to the established CENTAF targeting procedures. Lt Gen Horner and Brig Gen Glosson endorsed the Master Attack Plan because of the many interactions with Lt Col

[87] Putney, *Airpower Advantage: Planning the Gulf War Air Campaign 1989-1991*, 128.

Deptula and because they understood the methodology behind the Master Attack Plan. The isolation of the SPG and senior leadership endorsement effectively selected and integrated the Master Attack Plan into the ATO building process.

The next key selection mechanism was the re-organization of the TACC and CENTAF staff. This change to structure altered the interactions of the SPG and CENTAF staffs. A new planning, ATO production, and execution process emerged that integrated the experience and process of CENTAF with the strategic air campaign of the SPG. A new organization emerged that supported the efficient production of the ATO. The change in TACC physical location, coupled with the placement of Brig Gen Glosson in charge of Campaign Plans, reinforced the emergent organization and process. The re-organization merged offensive and defensive planning into a single organization and selected both plans.

Lessons Learned

During the planning for Desert Storm, GEN Schwarzkopf and Lt Gen Horner increased the amount of variation in the planning process. The request to Air Staff by GEN Schwarzkopf and the creation of the SPG created options outside the established planning process. In both cases, the unique composition of the tasked organizations increased the variation in approach and output. This indicates that outside input (increased variety) can be useful during a planning process. The trust between GEN Schwarzkopf and Lt Gen Horner allowed GEN Schwarzkopf to delegate authority, which led directly to the selection of the Instant Thunder plan. On the other hand, the lack of trust between the SPG and CENTAF staff created an emergent ad hoc network and emergent processes. Sometimes, isolation and a lack of resources spur creative solutions, although, difficulties may arise when integrating these creative solutions. Lt Gen Horner's decision to re-organize the TACC and put Brig Gen Glosson in charge of the combined planning

function integrated the SPG and solved this problem. This merger of organizations was a key selection mechanism and demonstrated TACS self-organization.

THE SCUD HUNT: FAILURE TO ADAPT

The Great Scud Hunt was a failure of the TACS to adapt during Desert Storm. Michael Gordon and GEN Bernard E. Trainor state "the Scud, not the airplane, was Iraq's primary weapon during the air war. CENTCOM's air strikes hindered the Iraqi missile crews, but they never stopped them."[88] The TACS as an organization failed to adapt, even after the Secretary of Defense emphasized the mission as his number one priority. The reasons for this failure stem from a lack of emphasis on the Scud mission by GEN Schwarzkopf and Lt Gen Horner, as well as a lack of accurate feedback on mission success, which led to insufficient variation within the system.

The Iraqi Scud was a Soviet made ballistic missile that could range Israel and Riyadh, Saudi Arabia from Iraq and had the capability to carry high explosives or chemical warheads. The Iraqis could fire Scuds from fixed sites or mobile transporter-erector-launchers. Tactically the Scuds did little damage to military targets, except for the Scud that killed twenty-eight US soldiers when it impacted the barracks in Dhahran, Saudi Arabia.[89] Strategically and politically, the Scuds greatly affected Coalition air operations. Officials within the Bush administration had anticipated that the Iraqis would use the Scud as a strategic weapon. The Bush administration feared that a Scud launched at Israel would lead to an Israeli reaction that could fracture the Coalition or result in a war between Jordan and Israel.

The Scud problem was the most significant strategic issue faced by CENTCOM during the execution phase of Desert Storm. Although a limited weapon, the Iraqis cunningly used the Scud to apply strategic pressure to the Coalition. Saddam Hussein's strategic aim was to draw

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[88] Michael R. Gordon, *The Generals' War: The Inside Story of the Conflict in the Gulf* (Boston: Little, Brown, 1995), 228.

[89] Department of Defense, *Conduct of the Persian Gulf War*, 166.

Israel into the war in order to fracture the Coalition.[90] The Bush administration had anticipated that Israel would be a target and had coordinated to have a secure communications link installed between the Department of Defense and the Israeli Ministry of Defense to facilitate direct communications.[91] After the initial attacks against Israel, Secretary of Defense Dick Cheney forced CENTCOM to increase the size of the anti-Scud campaign and personally reviewed the daily ATO to ensure that CENTCOM followed through.[92]

The Iraqis were able to launch eighty-eight Scuds at Israel and Saudi Arabia population centers and military targets during Desert Storm. The Iraqis launched all of the Scuds from mobile launchers. The number of launches peaked during the first and last weeks of the war, even though CENTAF and CENTCOM had placed considerable assets and attention towards the problem.[93] The Scud hunt consumed, on average, 6% of the total sorties per day, yet CENTAF failed to prevent the launching of Scuds.[94] In fact, the Iraqis were able to adapt and increase the number of launches in a coordinated manner during the last week of the war.[95]

The Coalition was successful in limiting the effect of the Scud launches through the integration of wide-area surveillance and the Patriot air defense missile batteries in Israel and Saudi Arabia.[96] Additionally, the strategic air campaign consistently targeted and attacked Scud

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[90] Ibid.

[91] Ibid.

[92] Gordon, *The Generals' War*, 232.

[93] Cohen, *Gulf War Air Power Survey*, Vol I, Part I, 246.

[94] Mark David Mandeles, *Managing "Command and Control" in the Persian Gulf War* (Westport, CT: Praeger, 1996), 74.

[95] Gordon, *The Generals' War*, 247.

[96] Mandeles, *Managing "Command and Control" in the Persian Gulf War*, 79.

production and assembly areas, as well as fixed launch sites.[97] CENTAF focused on how to suppress or eliminate the Scud threat by finding and destroying Scud launchers either before or after launch.

Before Desert Storm, the Iraqis developed and executed a plan to disperse the mobile Scud launchers. The fixed Scud sites in the desert west of Baghdad served as "decoys" because there is no evidence that Iraqi forces attempted to use the fixed launch sites.[98] The Iraqi forces deployed the mobile launchers to wartime hiding places before Desert Storm began.[99] In addition to dispersal, the Iraqi forces deployed "high-fidelity" decoys, paid commercial tractor-trailer trucks a special premium to drive from Baghdad to Jordan at night, and adapted Soviet pre-launch and launch "shoot and scoot" procedures that dramatically cut set-up times and electromagnetic emissions.[100] Iraq's operational approach contributed to the Coalition's ability to suppress, but never eliminate, the Scud threat.

The problem faced by CENTAF was finding, and striking, a mobile launching system in a vast desert with limited intelligence assets. The Soviet-built transporter-erector-launcher was difficult to detect from the air and easily concealed in the desert environment.[101] None of the tools available to the Coalition was suited to finding a small mobile point target in a vast desert, especially without a method to narrow the search. Before Desert Storm, the Air Force conducted trials with F-15E, F-111, and Low-Altitude Navigation and Targeting Infrared for Night

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[97] Cohen, *Gulf War Air Power Survey*, Vol I, Part I, 247.

[98] Ibid., Vol II, Part II, 333.

[99] Ibid.

[100] Ibid., Vol II, Part II, 334; Mandeles, *Managing "Command and Control" in the Persian Gulf War*, 77.

[101] Cohen, *Gulf War Air Power Survey*, Vol IV, Part I, 281.

(LANTIRN) equipped F-16 aircraft aimed at locating a Scud mobile launcher in the Californian desert at night. The trials discovered that the mobile launcher was "virtually impossible to find," even when the strike aircraft were given precise coordinates.[102] A DIA postwar assessment identified inadequate cueing of the strike aircraft and on-board sensor limitations as unresolved problems for locating and destroying mobile launchers.[103] The USAF possessed tools with limited ability to find a small mobile point target, which placed additional pressure on the integration and assessment processes. The *Gulf War Air Power Survey* argues "the systems available to find and then attack mobile Scud launchers from the air simply did not have the information they needed in time to carry out their mission successfully."[104] Similarly, a Defense Science Board report argued, "procedures and integration were ad hoc and not optimum … information to enable a successful attack could have been available with existing assets."[105] The Scud problem required detailed integration in order to be successful against the mobile launchers.

CENTAF split the operational approach to locate and destroy Iraqi Scuds into two phases. The first phase occurred during the strategic air campaign and targeted fixed sites related to Scud production, support, storage, and launch facilities.[106] The Scuds launched at Israel and Saudi Arabia triggered the second phase and this phase was aimed at locating and destroying Iraq's mobile Scud launchers. The second phase consisted of two parts: suppression tactics aimed at limiting movement of Scud-related vehicles and destruction of mobile launchers.[107] The

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[102] Ibid., Vol II, Part II, 335.

[103] Ibid., Vol II, Part II, 336.

[104] Ibid., Vol I, Part II, 251.

[105] Ibid., Vol I, Part II, 252.

[106] Ibid., Vol IV, Part I, 274–275.

[107] Ibid., Vol IV, Part I, 290.

suppression tactics involved dropping cluster bomb unit munitions from high altitude to scatter bomblets over a wide area as well as around suspected staging and launch areas.[108] Based on an idea developed within Checkmate staff in coordination with the DIA, the GAT targeted potential Scud hide sites to include culverts, overpasses, and bridges.[109] Israel offered similar target suggestions to CENTAF via the Pentagon.[110] These tactics were novel because they involved attacking locations without evidence of Scud movement using only logical guesses as a guide to targeting. [111] Lt Gen Horner and Brig Gen Glosson attempted to demonstrate to Israel and the Bush administration that CENTAF was applying maximum effort to eliminate Scud attacks.

CENTAF's second phase aimed at destroying the mobile launchers. The planners attempted to improve responsiveness in order to increase the likelihood of finding a launcher in the open. Before January 22, F-15Es sat ground alert over an hour away from western Iraq awaiting a Scud launch.[112] CENTAF did not want to fly combat air patrols because of the SAM threat. GEN Schwarzkopf ordered standing combat air patrols on January 22 and the TACC planned for two F-15Es to be on station from 1800L to 0900L.[113] Combat air patrols were the primary method to destroy mobile launchers. The *Gulf War Air Power Survey* sums up the chosen approach:

> Night combat air patrols were maintained by F-15Es equipped with synthetic aperture radar and LANTIRN targeting pods in the western launch area and by F-16s equipped with LANTIRN and Global Positioning System in the eastern area (or "box"). The F-16s,

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[108] Ibid., Vol IV, Part I, 290–291.

[109] Ibid., Vol IV, Part I, 291.

[110] Gordon, *The Generals' War*, 236.

[111] Cohen, *Gulf War Air Power Survey*, Vol IV, Part I, 291.

[112] Davis, *On Target: Organizing and Executing the Strategic Air Campaign Against Iraq*, 240.

[113] Ibid., 239.

> and occasionally the F-15Es in the western area worked in conjunction with JSTARS. A-10s were used for daylight-armed reconnaissance in both areas. Scud combat air patrols were supplanted by preplanned strikes against fixed targets.[114]

This approach began on second day of the war and lasted until the end of the conflict with only minor variations.[115] Essentially, Brig Gen Glosson adopted the first concept that appeared to be working to limit Scud launches and demonstrated a level of effort that would keep Israel out of the war. The only change was an increase in the quantity of effort by shifting more resources to the Scud problem.[116] At one point, Brig Gen Glosson ordered F-15Es to drop one bomb every half hour on suspected Scud sites to remind the Iraqis that US strike aircraft were overhead.[117]

US and British Special Operation Forces (SOF) aided in the reconnaissance and targeting of mobile Scuds. On January 24, British Commandos began conducting operations near H-2 in western Iraq to hunt for mobile scuds and disrupt Iraqi command and control. The Commandos provided feedback to the TACC through a special liaison officer who was able to pass along suppression targeting suggestions. US SOF began operations on February 7, also in the western Iraqi desert. An ad hoc communications link between the special operations teams and the combat air patrols required the teams to communicate through the Airborne Warning and Control System (AWACS) aircraft, which would in turn direct combat air patrol aircraft to the target area. Teams attempted unsecure direct communications with combat air patrols over "guard frequency" but risked enemy detection. These approaches were inefficient and ineffective. The addition of British liaison officers to the TACC improved the ad hoc nature of the communications link,

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[114] Cohen, *Gulf War Air Power Survey*, Vol IV, Part I, 285–286.

[115] Davis, *On Target: Organizing and Executing the Strategic Air Campaign Against Iraq*, 242.

[116] Rick Atkinson, *Crusade: The Untold Story of the Persian Gulf War* (Boston: Houghton Mifflin, 1993), 147.

[117] Ibid.

which helped to decrease response times. US forces did not provide a liaison to the TACC and operated independently unlike the British forces. Overall, the integration was not optimal and response times could be fifty minutes or more from target identification to ordnance delivery.[118] Special operations leadership proposed and received approval for the ground Scud hunt directly from to the Secretary of Defense, independent of CENTAF.[119] As a result, the CENTAF and US special operations lacked integration of planning and execution.

In late January, Lt Gen Horner and Brig Gen Glosson created a plan focused solely on the Scud threat. They planned to stop the air war and shift all efforts to the Scud hunt in western Iraq for three days.[120] The plan would have massed 2,000+ sorties per day and targeted underpasses, suspected hiding spots, and anything remotely associated with Scud operations.[121] Brig Gen Glosson compared it to carpet-bombing.[122] GEN Schwarzkopf decided not to execute the plan because of its indiscriminate nature and the shift of focus away from the destruction of the Republican Guard.[123] GEN Schwarzkopf intended only to minimize the Scud threat, not eliminate it, and only to placate the Israelis and the Bush administration.[124]

Several reports after Desert Storm assessed the Scud hunt as a tactical failure due to erroneous feedback that reinforced the appearance of success. Fighter aircraft, attack aircraft, and

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[118] William Rosenau, *Special Operations Forces and Elusive Enemy Ground Targets: Lessons from Vietnam and the Persian Gulf War* (Santa Monica, CA: Rand Corporation, 2001), 39.

[119] Gordon, *The Generals' War*, 244.

[120] Atkinson, *Crusade*, 147.

[121] Ibid.

[122] Ibid., 148.

[123] Gordon, *The Generals' War*, 237–238.

[124] Ibid., 237.

SOF claimed to have 'killed' over one hundred mobile launchers.[125] However, after the war US national intelligence sources could not confirm any mobile launcher 'kills.'[126] One reason the Scud hunt failed to adapt was that the campaign appeared to be succeeding. After the first two weeks of the war, Iraqi forces launched fewer Scuds and fighter and attack pilots reported destroying many mobile Scud launchers. These two facts reduced the pressure to adapt. The increase in the number of Scud launches during the last week of the war revealed this failure.[127]

Variation

Overall, the great Scud hunt involved a large variation in ideas that rarely translated into changes to CENTAF's approach. CENTAF increased the level of effort, but did not modify the operational approach. The number of aircraft assigned to finding mobile launchers increased, as did the number of fixed targets attacked for either destruction of Scud infrastructure or suppression of mobile launches.[128] CENTAF received inputs from Checkmate, the DIA, and Israel that led to the suppression targeting of potential hide sites.[129] The DIA deployed Military Intelligence Support Teams to CENTCOM Headquarters to expedite collection requests and intelligence dissemination.[130] US and British SOF forces provided additional variation through agents operating on the ground, but failed to increase success because the forces lacked planning, intelligence, and communications integration.

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[125] Ibid., 247.

[126] Cohen, *Gulf War Air Power Survey*, Vol II, Part I, 179.

[127] Ibid., Vol II, Part II, 339.

[128] Davis, *On Target: Organizing and Executing the Strategic Air Campaign Against Iraq*, 240–241.

[129] Cohen, *Gulf War Air Power Survey*, Vol IV, Part I, 291; Gordon, *The Generals' War*, 236.

[130] Cohen, *Gulf War Air Power Survey*, Vol IV, Part I, 250.

Three explanations stand out for the lack of variation of approach. First, planners and intelligence experts failed to predict the Iraqi Scud operating procedures during the war. Iraqi forces modified pre-launch and launch procedures to decrease detection and exposure time.[131] A better understanding of the problem by CENTAF planners may have altered the tactical approach. Second, the Scud campaign appeared to be succeeding because the number of Scud launches decreased after the first ten days of Desert Storm. This coincided with optimistic mission reports of destroyed mobile launchers that, after the war, were determined to be 'high fidelity decoys.'[132] Lt Gen Horner, Brig Gen Glosson, and CENTAF planners believed that the current tactics were succeeding. Thirdly, GEN Schwarzkopf and Lt Gen Horner intended only to placate Israel and the Bush administration and resisted shifting focus away from the main effort against Iraqi forces in Kuwait and the Republican Guard. The increase in the level of effort proved successful in keeping Israel out of the war, which further reduced the pressure to attempt new approaches. The misunderstanding of Iraqi tactics, the appearance of success, and a lack of pressure from leadership led to limited variation in the approach to the Scud problem.

Key Interactions

The most significant interaction occurred between intelligence collection, planners, and leadership. CENTCOM and CENTAF failed to collect accurate Battle Damage Assessment on the Iraqi mobile launchers. The fact that Iraqi forces had dispersed its Scuds and mobile launchers and practiced elaborate deception tactics further exacerbated this collection failure. In many

[131] Ibid., Vol II, Part II, 334.

[132] Ibid., Vol II, Part I, 179.

cases, overly optimistic pilots' reports and compelling video footage became the only available Battle Damage Assessment.[133] This flawed information reinforced the appearance of success.

The restriction of Israeli input into the planning and execution process proved to be a key interaction. In order to keep Israel out of the war without fracturing the Coalition, the Bush administration restricted Israeli inputs to the war effort. The Israelis had been studying the Scud problem and requested to have a liaison officer stationed at CENTCOM or on a Navy ship to facilitate intelligence sharing and influence targeting.[134] CENTCOM and the Bush administration did not accommodate this request, but did allow the Israelis to submit a target list of suspected Scud sites and hiding places.[135] Lt Gen Horner sent his deputy Maj Gen Tom Olsen to Israel to act as CENTCOM's anti-Scud liaison and directed him to reassure the Israelis while discouraging an Israeli military response.[136] This created a one-way interaction between CENTAF and the Israelis designed only to placate the Israelis, not to solve the Scud problem. US diplomats from the Bush administration, also sent to influence the Israelis, observed that Maj Gen Olsen did not know what "CENTCOM was actually doing" during the Scud campaign.[137] The limited interaction between Israel and CENTAF reduced the opportunity to find improved solutions to the Scud problem.

US and British SOF integration into the Scud campaign proved to be yet another key interaction. SOF and CENTAF failed to integrate effectively to meet the timelines necessary to find and destroy a mobile Scud launcher. SOF ground teams could not contact overhead aircraft

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[133] Ibid., Vol II, Part III, 339.

[134] Gordon, *The Generals' War*, 236.

[135] Ibid.

[136] Davis, *On Target: Organizing and Executing the Strategic Air Campaign Against Iraq*, 232.

[137] Gordon, *The Generals' War*, 236.

directly, but instead passed strike requests through AWACS by secure channels or resorted to unsecure communications over the "guard" frequency, reserved for aircraft emergencies.[138] This process averaged fifty minutes from request to ordnance delivery, giving the mobile Scuds ample time to relocate. [139] The British SOF attempted to solve this problem by stationing a liaison officer at the TACC. The liaison did provide Scud suppression targeting suggestions and provided a conduit for information flow, but this did not achieve the integration required to destroy the mobile Scuds. SOF could have been a key component in decreasing the response time, but it would have required a deeper level of integration. Detailed integration requires time to implement and additional time was not available during the air campaign.

The internal TACC process for directing strike aircraft to emerging Scud targets failed to address the time restraints of finding a mobile Scud. This key interaction involved planners within the TACC. A small group of planners attempted to redirect aircraft that had not yet taken off to emerging Scud targets.[140] The process failed to address the limited time available to prosecute a mobile Scud target because the tools to identify aircraft to re-task were not effective. The TACC developed a "change cell" that attempted to gather all of the information required to re-task aircraft, but failed to reduce the time required to process the required information. The lack of understanding of the time available to strike an emerging Scud and the time required to successfully deliver ordnance was never resolved and, as a result, Iraqi mobile Scuds escaped destruction. This too would have required more detailed integration within the TACC and

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[138] Rosenau, *Special Operations Forces and Elusive Enemy Ground Targets*, 39.

[139] Ibid.

[140] Michael W. Kometer, *Command in Air War: Centralized versus Decentralized Control of Combat Airpower* (Maxwell Air Force Base, AL: Air University Press, 2007), 159.

additional time to implement. Again, time was in short supply and the integration tools were not available to TACC planners.[141]

Selection Mechanisms

The most significant selection mechanism during the Scud hunt involved senior CENTCOM and CENTAF leadership downplaying the Scud threat. GEN Schwarzkopf viewed the Scud threat as militarily insignificant and attempted to keep the Coalition focused on Iraqi forces in Kuwait and the Republican Guard.[142] Accordingly, he chose not to execute the massive three-day Scud hunt plan. GEN Schwarzkopf wanted to keep Israel out of the war while minimizing the Scud problem. His attitude influenced the level of effort applied to the Scud problem and allowed CENTAF to continue to prosecute other Desert Storm objectives.

Brig Gen Glosson and Lt Col Deptula selected the initial alert tactic based on the need to not pull resources from the main strategic air campaign as well as an expectation that the TACS would be able to anticipate the location of mobile launchers either before or after launch.[143] The alert concept held until GEN Schwarzkopf forced the establishment of combat air patrols.[144] This selection balanced the operational objectives (defeat the Iraqi forces) with the strategic objective (keep Israel out of the war), which reduced the necessity for innovation. The main selection during the Scud hunt was the addition of resources to prove to the Israelis and the Bush administration that CENTCOM was putting forth a significant effort.

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[141] Ibid.

[142] Gordon, *The Generals' War*, 235.

[143] Atkinson, *Crusade*, 146–147.

[144] Davis, *On Target: Organizing and Executing the Strategic Air Campaign Against Iraq*, 239.

Lessons Learned

The lesson learned from the TACS failure to adapt to the mobile Scud threat is the importance of the commander in driving innovation. GEN Schwarzkopf and Lt Gen Horner both wished to minimize the Scud threat in order to placate Israel and the Bush administration. The Scud hunt achieved strategic success in keeping Israel out of the war, but failed tactically. This reduced the pressure to explore new solutions regardless of the possible variations available. Israel not entering the war achieved GEN Schwarzkopf's strategic objective. The second lesson is that feedback in the form of accurate Battle Damage Assessment is necessary to understand success and failure. Positive pilot reports and the reduction in Scud launches painted a picture of success that was not accurate. As a result, this reduced the pressure to adapt. The last lesson was that finding mobile launchers in a vast desert with an adaptable enemy requires detailed integration. The inclusion of SOF forces proved to be a step in this direction, but sufficient time was not available to reduce the time required to improve integration in order to successfully kill mobile launchers. Inefficient integration resulted in the failure to kill mobile Scuds, but not to achieve GEN Schwarzkopf's main objective to placate Israel.

THE REPUBLICAN GUARD: THREE EMERGENT ADAPTATIONS

GEN Schwarzkopf's focus on the Iraqi fielded forces in Kuwait and the Republican Guard led to adaptations within the TACS. This focus supported the US policy objective that stated US actions would secure "the immediate, unconditional, and complete withdrawal of Iraqi forces from Kuwait."[145] To meet this objective, CENTCOM planners determined it would be necessary to "reduce to about half the combat effectiveness of Iraqi armor and mechanized forces with Coalition air assets."[146] GEN Schwarzkopf had repeatedly stressed that a fifty percent reduction in Iraqi fielded forces would be required to successfully conduct a ground offensive in Kuwait. Lt Gen Horner's air campaign objectives included the elimination of Iraq's offensive capability, which further reinforced the need to destroy a large part of the Iraqi Army.[147]

The opening days of the Desert Storm air campaign were a success; Coalition air forces sustained light losses. Lt Gen Horner declared air supremacy on D+10 (January 27), signaling that Coalition aircraft could operate over Iraq and Kuwait with virtual impunity.[148] By the end of the second week, Lt Gen Horner received pressure to shift targeting emphasis to the Republican Guard and Iraqi forces in Kuwait.[149] Specifically, GEN Schwarzkopf directed Lt Gen Horner to shift air assets to focus to Kuwait on January 27. Adding to the pressure on January 31, Army Forces Component CENTCOM reported to GEN Schwarzkopf that the Republican Guard "stood at 99 percent of its pre-war strength: 98 percent of its tanks remained, as did 99 percent of its

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[145] Department of Defense, *Conduct of the Persian Gulf War*, 19.

[146] Ibid., 70.

[147] Ibid., 95.

[148] Ibid., 127.

[149] Cohen, *Gulf War Air Power Survey*, Vol II, Part I, 204.

armored vehicles and 99 percent of its artillery."[150] This surprised the planners at CENTAF because 300 F-16 and twenty-four B-52 sorties had flown against the Republican Guard in the first two weeks of the war.[151] This led CENTAF to implement adaptations aimed at destroying Iraqi tanks, armored personnel carriers, and artillery. These adaptations were the Killer Scout missions, the tank plinking missions, and deep interdiction by A-10 aircraft.

The Killer Scout missions originated out of historical precedence and 'operator' initiative.[152] Brig Gen Glosson faced an operational problem with the lack of reported destruction of the Republican Guard. F-16 pilots faced a tactical problem caused by weather, a lack of time available to find targets, and a difficulty in identifying targets from medium altitude. Additionally, it was extremely difficult to provide accurate battle damage assessment for many of the same reasons. The Killer Scout concept emerged from two sources, almost simultaneously.

Brig Gen Glosson tasked a group of instructors from the USAF Fighter Weapons School to solve the problem.[153] The instructors looked back at recent history, specifically Vietnam, and discovered that the USAF had used a Fast Forward Air Controller (FAC) concept to solve many of the same problems.[154] In Vietnam, Fast FACs had provided aerial surveillance and controlled air strikes in areas where significant surface to air defenses existed. The planners proposed using the F-16 because of its maneuverability, self-defense capability, navigation system, and multi-

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[150] Jamieson, *Lucrative Targets*, 95.

[151] Ibid., 75.

[152] Ibid., 74.

[153] Mark A. Welsh, "Day of the Killer Scouts," http://www.airforcemag.com/MagazineArchive /Pages/1993/April%201993/0493scouts.aspx (accessed February 25, 2014).

[154] Ibid.

purpose radar.[155] Brig Gen Glosson liked the idea and asked the instructors to create a concept of operations.

At about the same time, officers in the 388th Tactical Fighter Wing (TFW), which flew F-16s, suggested, "an airborne platform be stationed in the second echelon areas to validate Air Tasking Order targets and find new targets if required."[156] The message was a result of an experiment by the 388th TFW to improve target acquisition. The mission planners internally rescheduled aircraft launch times so that one flight could launch early in order to reconnoiter each of the subsequent flight's targets.[157] This was 'operator' initiative at the wing level. As it turned out, the Fighter Weapons School instructors and the 388th TFW proposals were nearly identical. The proposals molded together the capabilities of the F-16 with a Vietnam era tactic.

The innovation was a result of agents at the TFW and TACC trying to solve a problem. The TFW officers were attempting to solve a tactical problem that arose from weather, altitude restrictions, and the lack of time available over target. The mission planners at the 388th TFW were extremely familiar with the capabilities of the F-16 as well as the tactical problem facing the pilots over Iraq. The Fighter Weapons School instructors were attempting to solve an operational problem of increasing the overall TACS effectiveness against the Republican Guard. The Killer Scout tactic proved to be very effective at locating enemy targets, delivering ordnance, and providing accurate and timely battle damage assessment.

In an effort to increase nighttime effectiveness, the tank plinking adaptation emerged. Tank plinking involved the the use of 500 lb. laser-guided bombs against point targets,

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[155] Ibid.

[156] Ibid.

[157] William F. Andrews, *Airpower against an Army: Challenge and Response in CENTAF's Duel with the Republican Guard* (Maxwell AFB, AL: Air University Press, 1998), 51, http://www.dtic.mil/get-tr-doc/pdf?Location=U2&doc=GetTRDoc.pdf&AD=ADA391351 (accessed February 26, 2014).

specifically dug-in Republican Guard tanks. This was not an anticipated use of precision weapons by TACS planners before the beginning of Desert Storm. F-111s with Pave Tack laser designator pods at medium altitude would expend 500 lb. laser guided bombs against dug-in tanks at night. This required a modification in thinking on the employment of precision weapons and on the feasibility of using the F-111 at medium altitude.[158] Planners originally targeted precision weapons against only fixed strategic targets. The limited availability of both laser guided bombs and platforms capable of dropping laser-guided bombs created a resource competition between strategic targets in Iraq and fielded forces in Kuwait. Before Desert Storm, F-111 crews trained for low-altitude single pass night attacks in order to survive against enemy surface to air missiles and anti-aircraft artillery.[159] The planners had to overcome these impediments for tank plinking to come into fruition. The resource competition was resolved when Lt Gen Horner shifted the air campaign focus to the Republican Guard in late January.[160] The medium altitude plan required Brig Gen Glosson to personally convince the F-111 TFW Commander of the feasibility of the tactic.

The CENTAF staff suspected that laser guided bombs could be used to target tanks as early as December 1990. During a Desert Shield training exercise called Night Camel, pilots discovered that tanks in the desert were clearly "visible" with infrared sensors, especially between sunset and midnight.[161] The intent of Night Camel was to determine whether infrared equipped

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[158] Ibid., 54.

[159] Ibid.

[160] Jamieson, *Lucrative Targets*, 55.

[161] Michael J. Bodner and William W. Bruner III, "Tank Plinking," http://www.airforcemag.com /MagazineArchive/Pages/1993/October%201993/1093plinking.aspx (accessed February 23, 2014).

aircraft could interdict supply lines and drop cluster munitions against tanks at night.[162] CENTAF planners reviewed F-111 cockpit videotapes from Night Camel. It is not clear where the tank-plinking idea specifically originated. What is clear is that on February 4, Maj Gen John A. Corder, the CENTAF Director of Operations, recommended that F-111s attack armor, vehicles, and artillery in Kuwait.[163] The idea may have emerged during informal tactics discussion held at CENTAF that included many senior generals. The F-111 TFW Commander successfully led and flew the first tank-plinking mission on February 5. Lt Gen Horner reviewed video of the initial success and, as a result, he ordered all laser guided bomb capable F-111s to shift from the strategic campaign to the new tank plinking mission.[164] Later in February, Navy A-6s and F-15Es conducted tank-plinking missions. Tank plinking proved to be extremely successful, with F-111s credited with destroying over 1,000 tanks during the war.

The third adaptation that aimed at the destruction of the Republican Guard was that of deep interdiction missions by A-10s. In the first two weeks of Desert Storm, A-10s operated near the Kuwaiti border and at higher altitudes than normal close air support missions. With the additional pressure to destroy the Republican Guard, A-10 missions were shifted either on the ATO, or airborne, deeper into the battlefield and allowed to fly at lower altitudes.[165] The A-10 was designed for close air support against Soviet tanks, so it was a natural adaptation to use A-10s against the Republican Guard forces. This adaptation was successful at increasing the rate of destruction of Iraqi forces, but it came at a cost. On February 15, Iraqi forces shot down two A-

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[162] Ibid.

[163] Jamieson, *Lucrative Targets*, 55.

[164] Department of Defense, *Conduct of the Persian Gulf War*, Vol II, Part I, 205.

[165] Cohen, *Gulf War Air Power Survey*, Vol II, Part I, 280.

10s and badly damaged another A-10 during operations over the Republican Guard.[166] Based on two lost A-10s, Lt Gen Horner restricted A-10 flights to within twenty nautical miles of the Kuwaiti border.[167] Lt Gen Horner received weekly letters from the A-10 TFW Commander, Col David Sawyer. On February 16, Col Sawyer stated, "A-10s over the Republican Guards and F-16s in the southern Kuwaiti Theater of Operations doesn't compute."[168] This reinforced Lt Gen Horner's decision to restrict A-10 missions to the threat reduced Saudi Arabia-Kuwait border.

Variation

Variation amongst the agents and the purposeful behavior within the TACS led to the Killer Scout, tank plinking, and A-10 deep interdiction concepts. Lt Col William F. Andrews, an F-16 pilot during Desert Storm, identified three groups as originators of innovations.[169] The first group was a network of junior officers that linked the GAT, wing planning cells, and flying squadrons.[170] The second group was the small group of Fighter Weapons School instructors within the TACC who acted as "troubleshooters."[171] The final group compromised the CENTAF senior leaders to include General Officers and the Wing Commanders.[172] These three groups represented a variation amongst agents. Brig Gen Glosson added diversity by inviting the Fighter

[166] Ibid., Vol II, Part I, 279.

[167] Ibid.

[168] Ibid., Vol II, Part I, 280.

[169] Andrews, *Airpower against an Army: Challenge and Response in CENTAF's Duel with the Republican Guard*, 57.

[170] Ibid.

[171] Ibid.

[172] Ibid.

Weapons School instructors to the CENTAF staff. The three groups varied in composition and purposeful behavior, which led to variation of solutions.

The variation in purposeful strategy resulted from combinations of the type of airframe, the tactic of delivery, and time of the mission. Planners and senior leaders could compare the Killer scout, tank plinking, and A-10 interdiction missions. The combination of infrared Pave Tack and precision laser guided bombs emerged as the most powerful variation.

Key Interactions

Interaction occurred on several levels. The first was at the senior officer level within CENTAF and between the wing leadership. This allowed for the free flow of information to compare options. The wing leadership informed CENTAF of the struggles faced by F-16 pilots due to weather, target identification, and time available over target, as well as, the success of the initial Killer Scout experiment. The F-111 TFW Commander initially opposed the medium altitude tank-plinking mission, but, when ordered, led the mission to resounding success. The A-10 TFW Commander also reinforced the costs versus benefits of the A-10 deep interdiction mission. These interactions led to the discovery of problems and solutions by connecting tactical experts with operational commanders.

The interaction between Brig Gen Glosson and the Fighter Weapons School instructors brought into CENTAF as tactical experts would bring together the lessons of Vietnam with current advanced technology capabilities. The instructors were able to fly with the various TFWs to better understand the challenges faced by individual units.[173] Additionally, much like the SPG planners, these experts had extensive connections to the TFWs that aided in the interaction

[173] Ibid., 40.

between agents.[174] This interaction is important for a couple of reasons. The Fighter Weapons School instructors received funding and time to visit and fly with the deployed wings. This yielded an eyes-on accounting of both problems and possible solutions. In addition, this established and strengthened the ad hoc connections at the junior officer level between the TFW and the TACC.

CENTAF senior leadership made these interactions possible by creating an environment that welcomed honest assessment of failure and innovative solutions. Lt Gen Horner led the way early in the war when he stated: "If you have a good idea about tactics or target selection or things of that nature, they are always welcome ... Everybody has experience in one form or another in tactical aviation and we need to talk to one another about it."[175] This allowed small informal groups to propose solutions. These discussions occurred within and between the SPG, the Fighter Weapons School instructors, and the CENTAF senior staff.[176] Brig Gen Glosson served as a key node interacting with all three groups while directing the TFW commanders under his command. The Killer Scout experiment demonstrated the openness to new approaches. Lt Gen Horner also served as a key node for interactions between GEN Schwarzkopf, Army Component Central Command, and the CENTAF senior leadership.

Selection Mechanisms

Two selection mechanisms standout in this case, the first was the selection mechanism used to adopt the Killer Scout and tank plinking adaptations. The other mechanism was the leadership decision to restrict A-10 flights to the Saudi Arabia-Kuwait border.

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[174] Ibid.

[175] Ibid., 57.

[176] Ibid., 40.

Killer Scout and tank plinking selection occurred in a three-step process. The first step was a limited experiment. In the Killer Scout case this occurred internal to the 388th TFW and in the tank plinking case this occurred during the Night Camel missions in late December. Next, CENTAF placed a small-scale demonstration on the ATO. This occurred on February 3 for the Killer Scout with eight pilots in 388th TFW. Mission reports from the units that worked with the Killer Scouts indicated that the concept was a success and planners should expand the concept.[177] The pilots of the 388th TFW helped the CENTAF staff to improve details of the concept. Based on the initial success, CENTAF rapidly expanded the concept to cover from sunrise to sunset.[178] For tank plinking, this ATO demonstration occurred on February 5. CENTAF repeated the concept over the next several days. The emphasis on the Republican Guard by GEN Schwarzkopf and the lack of Republican Guard battle damage assessments placed pressure on Lt Gen Horner and the TACS to improve real and perceived effectiveness. Lt Gen Horner and Brig Gen Glosson both understood the Killer Scout concept because it was similar to the Vietnam era Fast FAC concept. This created a level of comfort with the tactic.[179] Additionally, the success of the first ATO Killer Scout missions led to an expedited expansion of the concept.[180] The Killer Scout adaptation increased the effectiveness of the CENTAF effort against the Republican Guard during the day and tank plinking increased effectiveness at night.

Lt Gen Horner's leadership decision to restrict A-10s to the Kuwaiti border demonstrated a command selection mechanism. Although the losses of A-10s up to that point were within

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[177] Welsh, "Day of the Killer Scouts."

[178] Ibid.

[179] Andrews, *Airpower against an Army: Challenge and Response in CENTAF's Duel with the Republican Guard*, 52.

[180] Jamieson, *Lucrative Targets*, 76.

historical norms and they were having a positive effect, Lt Gen Horner selected to kill the adaptation. It is likely that the success of the Killer Scout adaptation during the day and the tank plinking adaptation at night coupled with the overall success of Coalition air operations led Lt Gen Horner to assess that it was no longer worth the risk to expose A-10s to the Republican Guard.[181] Lt Gen Horner made a decision based on the information available that balanced risk with the necessity of success.

Lessons Learned

The creation of an environment that welcomes risk taking and innovation is the key takeaway from the adaptations to destroy the Republican Guard. Lt Gen Horner's attitude and actions created an environment where innovation could flourish. He trusted his subordinates to experiment and find solutions to problems. Brig Gen Glosson reinforced this environment by bringing in the Fighter Weapons School instructors as troubleshooters. Lt Gen Horner and Brig Gen Glosson recognized that aerial warfare required solutions to unforeseen problems. As a result, CENTAF produced a variety of operational approaches that could be tested and selected. The selection mechanism (a small-scale demonstration followed by rapid expansion) required a small initial resource expenditure. As a result, planners and problem solvers could attempt many different solutions and rapidly expand the successful solutions. Three factors contributed to CENTAF's success in adapting: recognition of the need to adapt, an environment that encouraged adaptation, and a selection mechanism that could start small and rapidly expand.

[181] Cohen, *Gulf War Air Power Survey*, Vol II, Part I, 280.

CONCLUSION

Tomorrow's warfighter will face a complex environment. The TACS must be flexible and responsive in order to adapt to this environment. The TACS cannot remain static. It must change its structure, composition, and purposeful behavior to match the complexity of the environment. The *2014 Quadrennial Defense Review* states:

> We will actively seek innovative approaches to how we fight, how we posture our force, and how we leverage our asymmetric strengths and technological advantages. Innovation is paramount given the increasingly complex warfighting environment we expect to encounter.[182]

As stated in the introduction, Desert Storm was the first demonstration of standoff precision weapons, stealth technologies, and Global Positioning Satellite system. These factors linked the United State's strategic success to technology. The TACS was central to this technological focus and strategic success. Desert Storm signaled an inflection point in the gathering, management, and analysis of information within the TACS that led to the establishment of the AOC as a weapons system. The TACS during Desert Storm was a Complex Adaptive System that anticipated, self-organized, and adapted in facing a complex operating environment.

Two enduring lessons and a note of caution emerge from Desert Storm. First, variety plays an important role in the TACS. Increasing variety leads to improved solutions even when the solution is from an organization or person outside the normal process. The second lesson is that leadership plays a key role in setting the conditions for innovation. The note of caution is that the greater the required integration to solve a problem, the more time and resources necessary.

During the planning for Desert Storm, GEN Schwarzkopf and Lt Gen Horner increased the amount of variation in the system by establishing independent planning processes through the Air Staff and SPG. During the re-organization, Lt Gen Horner integrated the SPG and ad hoc

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[182] Department of Defense, *Quadrennial Defense Review 2014*, VII.

network into the TACC. The TACS demonstrated self-organization through the SPG's ad hoc network and the TACC re-organization.

The failure of the TACS to adapt during the Scud hunt was due in part to GEN Schwarzkopf's and Lt Gen Horner's attitudes toward the Scud threat. GEN Schwarzkopf viewed the Republican Guard as the higher priority threat and this reduced the pressure to innovate. Inaccurate Battle Damage Assessments reinforced perceived success, which further reduced the pressure to innovate. When faced with a thinking, adapting enemy, planners should understand the fallibility of Battle Damage Assessment. The Scud hunt tactically failed to find mobile launchers but did strategically succeed in keeping Israel out of the war. The Scud hunt required detailed integration and detailed integration requires increased time and resources both of which were in short supply.

The finding that emerges from the adaptations to destroy the Republican Guard is that leadership plays a key role in establishing an innovation-friendly environment. The environment is reflected in the ad hoc networks and organizations established throughout the TACS. Lt Gen Horner encouraged risk taking to solve problems and the addition of problem solvers from outside the organization. The Killer Scout and tank plinking innovations emerged as complementary operational approaches that led to greater destruction of the Republican Guard. CENTAF planners could attempt many different solutions because each approach started with a small-scale demonstration that required a small initial resource expenditure. Thus, planners and problem solvers could attempt many different solutions and rapidly expand those deemed successful.

Four themes emerge from the TACS during Desert Storm. The first theme is that *increased variety* or diversity of agents and purposeful behaviors are beneficial. The diversity of agents within the TACS led to improved planning for Desert Storm and improved solutions for destroying the Republican Guard. The next theme is that *leadership plays a key role in creating*

an environment of cooperation, collaboration, and competition *that encourages innovation and risk-taking*. Agents should embrace competition, while leaders should balance competition and cooperation. GEN Schwarzkopf did not fear the Instant Thunder plan as Washington, DC meddling, but instead embraced the diversity of input. Similarly, Lt Gen Horner encouraged the interactions that led to the tank plinking and Killer Scout innovations. The next theme is the *inaccuracy of Battle Damage Assessment*, especially, when the enemy is learning and adapting. During the Scud hunt, overly optimistic pilot reports did not consider the possibility of decoys and this led to reduced pressure to adapt. Ironically, CENTCOM disagreements on the destruction of the Republican Guard drove innovation because of the perceived lack of success. The last theme that emerges is that the TACS should *encourage the creation of ad hoc organizations and networks* to solve complex problems and then integrate the successful solutions. The SPG was the key ad hoc organization from which an informal network and new processes emerged. The re-organization of the TACC integrated the SPG into the formal TACS structure.

Recommendations

Complex Adaptive Systems provided an effective lens to view the TACS. Much of the writing about Desert Storm and the TACS revolves around personalities, specifically GEN Schwarzkopf, Lt Gen Horner, Brig Gen Glosson, and Lt Col Deptula. The theory of Complex Adaptive Systems delivered a more nuanced view that placed emphasis on the internal composition of the system and downplayed the role of individual personalities. Visionary leaders are a necessary component to successful adaptation, but only one component of many. The role of variation and interaction provides levers that agents can use to change the pace of innovation within any system, including the TACS.

The recommendations for the future of the TACS revolve around people, organizations and leadership. Several recommendations emerge that will improve the TACS translation of

strategy into effects. First, leaders within the TACS should foster an environment that encourages risk taking and innovation at all levels. Adaptation requires a diversity of approaches and agents. In order to find "successful" ideas, many approaches must be proposed and tested. Organizations and leaders should embrace diversity from sources inside and outside of their organization. In order to confront complex environments, the TACS will require inputs from new sources of information and new approaches to increase the likelihood of finding an optimal solution. Leaders should seek out diverse agents and purposeful behaviors for inclusion into TACS processes. Seeking an outside opinion to create diversity should be embraced, not avoided.

Next, the TACS, in general, and the AOC, in specific, should accept and integrate ad hoc organizations and networks. During Desert Storm, the re-organization of the TACC was not a unique event, but should be viewed as a requirement to overcome a complex environment. The TACS needs to grow and adapt to meet or exceed the complexity of the current environment. Organizations can, and should, anticipate future threats and needs. Change is a fundamental necessity when dealing with a complex environment and an adapting enemy. The TACS must anticipate future needs then adapt to meet those needs through effective leadership that encourages innovation and diversity of ideas.

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